ENANTIOCOMPLEMENTARY SYNTHESIS OF CHIRAL ALCOHOLS COMBINING PHOTOCATALYSIS AND WHOLE-CELL BIOCATALYSIS IN A ONE-POT CASCADE PROCESS

Yongzhen Peng, Department of Chemistry, Zhejiang University, China
pengyongzhen@zju.edu.cn, llc123@zju.edu.cn
Jian Xu, Department of Chemistry, Zhejiang University, China
Xianfu Lin, Department of Chemistry, Zhejiang University, China
Qi Wu, Department of Chemistry, Zhejiang University, China

Key Words: photocatalysis; enzyme catalysts; whole-cell process; one-pot cascade; chiral alcohols

As a powerful tool in synthetic organic chemistry, photocatalysis has the features of green, better atom economy, and mild conditions [1-2]. Recently, some cascade reaction protocols have been properly designed by combining photocatalysis and biocatalysis[3-4]. For example, Zhao and Hartwig reported an asymmetric reaction which coupled photocatalysts for E/Z isomerization of alkenes with ene-reductases for the reduction of carbon–carbon double bonds, to generate valuable enantioenriched products [5], which achieved the dual-advantages of both photocatalysis and biocatalysis. We envisioned a photochemo-enzymatic one-pot whole-cell process to convert a series of carboxylic acids into corresponding chiral alcohols with good yields (up to 93%) and excellent stereoselectivity (up to 99% ee). The photocatalysis step was conducted in aqueous phase by using O_2 as oxidant and the following whole cell bioreduction without the addition of the expensive cofactor NADPH was a much milder and more efficient approach to obtain chiral alcohols. All these advantages indicate that the photochemo-enzymatic one-pot transformation may have great potential in green synthetic chemistry.

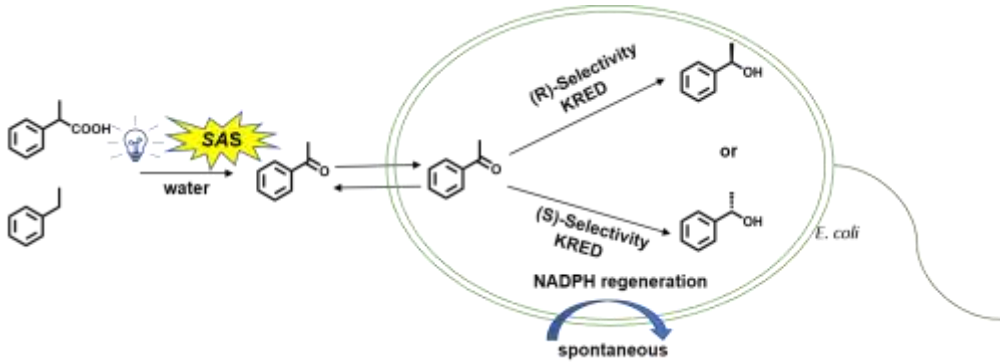

Figure 1 – Photochemo-enzymatic one-pot cascade in the whole-cell reaction system.

This abstract is subjected to the topic of Biocatalysis and enzymology.

References

[1] G. Ciamician, Science 1912, 36, 385 – 394.
[2] Z. Zuo, H. Gong, W. Li, J. Choi, G. C. Fu and D. W. C. MacMillan, J. Am. Chem. Soc., 2016, 138, 1832–1835.
[3] K. Lauder, A. Toscani, Y. Qi, J. Lim, S. J. Charnock, K. Korah and D. Castagnolo, Angew. Chem., Int. Ed., 2018, 57, 5803–5807.
[4] W. Zhang, B. O. Burek, E. Fernandez-Fueyo, M. Alcalde, J. Z. Bloh and F. Hollmann, Angew. Chem., Int. Ed., 2017, 56, 15451–15455.
[5] Z. C. Litman, Y. Wang, H. Zhao, J. F. Hartwig, Nature 2018, 560, 355–359.